**WHAT IS CLAIMED IS:**

1. A system for forming a wellbore in a subterranean formation, comprising:

(a) a drilling system including a rig positioned at a surface location, a drill string conveyed into the wellbore by the rig, the drill string having a bottomhole assembly (BHA) attached at an end thereof, and a plurality of sensors associated with the drilling system for measuring surface responses and downhole responses of the drilling system during drilling; and

(b) a controller operatively coupled to the drilling system and including at least one model for predicting behavior of the drilling system, the controller utilizing the at least one model, the measured surface and downhole responses and at least one selected control parameter to predict behavior of the drilling system and determine at least one advice parameter that produces at least one selected optimized drilling parameter while satisfying at least one selected constraint.

2. The system according to claim (1) wherein the at least one selected control parameter is one of: (i) weight-on-bit, (ii) RPM of the drill string, (iii) RPM of the drill bit; (iv) hook load, (v) drilling fluid flow rate, and (vi) drilling fluid properties.

3. The system according to claim (1) wherein the surface responses are one of (i) surface torque, (ii) oscillations of hook load, (iii) and rate-of-penetration, and (iv) oscillation of torque.

4. The system according to claim (1) wherein the downhole responses are one of (i) drill string vibration, (ii) BHA vibration, (iii) weight-on-bit, (iv) RPM of the drill bit, (v) drill bit RPM variations, and (vi) torque at the drill bit.

5. The system according to claim (1) wherein the at least one advice parameter is one of (i) drilling fluid flow rate; (ii) drilling fluid density, (iii) weight-on-bit, (iv) drill bit

RPM, and (v) bottomhole pressure.

6. The system according to claim (1) wherein the at least one selected optimized drilling parameter is one of: (i) rate-of-penetration, (ii) hole cleaning, and (iii) annular pressure.

7. The system according to claim (1) wherein the at least one model utilizes data relating to one of: (i) geometry of the BHA, (ii) mechanical parameters of the BHA, (iii) characteristics of a drill bit carried by the BHA, (iv) characteristics of a drilling motor in the BHA; (v) wellbore geometry, (vi) well profile; (vii) lithology of the subterranean formation being drilled; (viii) mechanical properties of the subterranean formation being drilled; (iv) lithology data obtained of an offset well; and (viii) formation mechanical property data obtained from an offset well.

8. The system according to claim (1) wherein the controller includes a plurality of model modules, each the model module producing a predicted value of a future response and cost associated with the future response, the controller utilizing the plurality of model modules to evaluate drilling efficiency.

9. The system according to claim (1) wherein the controller updates the at least one model in real-time using an error calculation between a measured value for a drilling system response and a predicted value for the drilling system response.

10. The system according to claim (1) wherein the selected drilling response includes a measured downhole response that is preprocessed and decimated by a downhole tool; and further comprising a telemetry system for transmitting the decimated and preprocessed measured downhole response to the controller.

11. The system according to clam (1) wherein the controller utilizes hole cleaning and annular pressure calculations to determine whether an annulus of the wellbore is

overloaded with cuttings formed during drilling.

12. The system according to claim (1) wherein the controller provides closed-loop control for the drilling system wherein the determined advice parameter is used to issue appropriate command signals to the drilling system.

13. The system according to claim (1) wherein the controller includes a neural network.

14. A method for forming a wellbore in a subterranean formation, comprising:
(a) providing a drilling system including a rig positioned at a surface location, a drill string conveyed into the wellbore by the rig, the drill string having a bottomhole assembly (BHA) attached at an end thereof,
(b) measuring surface responses and downhole responses of the drilling system during drilling using a plurality of sensors; and
(c) determining at least one advice parameter that produces at least one selected optimized drilling parameter while satisfying at least one selected constraint using a controller, the controller making the determination using at least one model for predicting behavior of the drilling system, at least one selected control parameter, and the measured surface and downhole responses.

15. The method according to claim (14) wherein the at least one selected control parameter is one of: (i) weight-on-bit, (ii) RPM of the drill string, (iii) RPM of the drill bit; (iv) hook load, (v) drilling fluid flow rate, and (vi) drilling fluid properties.

16. The method according to claim (14) wherein the surface responses are one of (i) surface torque, (ii) oscillations of hook load, (iii) and rate-of-penetration, and (iv) oscillation of torque.

17. The method according to claim (14) wherein the downhole responses are one of

(i) drill string vibration, (ii) BHA vibration, (iii) weight-on-bit, (iv) RPM of the drill bit, (v) drill bit RPM variations, and (vi) torque at the drill bit.

18. The method according to claim (14) wherein the at least one advice parameter is one of (i) drilling fluid flow rate; (ii) drilling fluid density, (iii) weight-on-bit, (iv) drill bit RPM, and (v) bottomhole pressure.

19. The method according to claim (14) wherein the at least one selected optimized drilling parameter is one of: (i) rate-of-penetration, (ii) hole cleaning, and (iii) annular pressure.

20. The method according to claim (14) wherein the controller is provided with at least one model used to determine the advice parameter, the at least one model utilizing data relating to one of: (i) geometry of the BHA, (ii) mechanical parameters of the BHA, (iii) characteristics of a drill bit carried by the BHA, (iv) characteristics of a drilling motor in the BHA; (v) wellbore geometry, (vi) well profile; (vii) lithology of the subterranean formation being drilled; (viii) mechanical properties of the subterranean formation being drilled; (iv) lithology data obtained of an offset well; and (viii) formation mechanical property data obtained from an offset well.

21. The method according to claim (14) wherein the controller includes a plurality of model modules, each model module producing a predicted value of a future response and cost associated with the future response, the controller utilizing the plurality of model modules to evaluate drilling efficiency.

22. The method according to claim (14) wherein the controller updates the at least one model in real-time using an error calculation between a measured value for a drilling system response and a predicted value for the drilling system response.

23. The method according to claim (14) wherein the selected drilling response

includes a measured downhole response that is preprocessed and decimated by a downhole tool; and further transmitting the decimated and preprocessed measured downhole response to the controller with a telemetry system.

24. The method according to claim (14) wherein the controller utilizes hole cleaning and annular pressure calculations to determine whether an annulus of the wellbore is overloaded with cuttings formed during drilling.

25. The method according to claim (14) wherein the controller provides closed-loop control for the drilling system, wherein the determined advice parameter is used to issue appropriate command signals to the drilling system.

26. The method according to claim (14) wherein the controller includes a neural network.